LETTERS TO THE EDITOR.

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Temperature in the Sun.

WHENEVER a spell of hot weather occurs it is common to see published accounts of the "temperature in the sun." These sun-temperatures have little meaning unless the other surrounding conditions are also stated.

Comparatively few people realise that a thermometer indicates nothing except the temperature of the fluid in its bulb, and that to draw any useful inference from that temperature it is necessary to know how the heat which produced it was supplied.

Heat may enter a thermometer from the air by conduction, aided by convection currents and wind, and also by radiation from distant objects. In general, both these sources contribute to the total.

The true temperature of the air is indicated only when the thermometer is screened from the radiation of any body which is not at that temperature, and the ventilated shelters in which meteorologists place their instruments are intended to secure this condition. In ordinary cloudy and windy weather they answer the purpose, but in sunshine and calms the whole shelter becomes heated, and the thermometer readings are too high.

When a thermometer is fully exposed to the sun a large part of the heat received is supplied by radiation, and the apparent temperature will vary with the character of the surroundings, including the nature of the glass of which the bulb is made.

Of the total radiant energy falling on the bulb part is regularly reflected and the remainder scattered or absorbed, but it is only the energy absorbed during its passage through the glass of the bulb which raises the temperature of the contents—at any rate, in mercury thermometers. The limiting temperature is reached when the surface of the bulb loses, by conduction and dark radiation, as much heat as will balance the supply.

If the bulb is smoked there is scarcely any reflection, and thus a bulb coated with lampblack will reach a higher temperature than a black glass bulb, and this, in turn, will be higher than if the glass is transparent, and if the exterior of the bulb is silvered there will be an even greater difference.

Thus, in the same place and in the same sunlight, four different temperatures might be indicated by accurate thermometers, each reading differing from the others by several degrees, the differences depending on the different absorptive and emissive qualities of the glass and its surface.

The actual difference between the apparent "temperature in the sun" and the air temperature may in this country be as great as 50° F. In the tropics I believe it may be considerably more.

Darwin, when in the Galapagos Islands, wrote:—"On two days the thermometers in the tent stood for some hours at 95°, but in the open air in the wind and sun at only 85°. The sand was extremely hot; the thermometer placed in some of a brown colour immediately rose to 137°, and how much above that it would have risen I do not know, for it was not graduated any higher. The black sand felt much hotter. . . ." The true air temperature was probably about 80°, so that the sun's radiation heated the ground 60° or 70° more than air.

I remember seeing in a sunny window in January the thermometer standing at 108° when the room temperature was about 60°; and in the recent warm weather, when the air temperature was about 80°, a thermometer shielded from draught by a thin smoked glass tube indicated 128°.

These facts show how little meaning can be attached to "temperatures in the sun" unless all the conditions are stated.

If a blackened thermometer is enclosed in a good vacuum chamber of transparent glass, and is carefully screened from all ground radiation, its readings in the sun will give a good comparative measure of the transparency of the air to radiant heat; but if the true temperature of the air is required, the thermometer should be surrounded by two or more concentric silvered glass tubes through which a rapid draught is maintained. In this way the effects of radiation are almost eliminated, and all the heat received is supplied by conduction.

A. MALLOCK.

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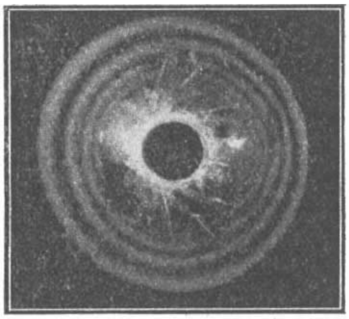
Percussion Figures in Isotropic Solids.

THE accompanying photographs are of interest as illustrating the manner in which an isotropic solid breaks down under the stresses set up by impact when these exceed the limits of perfect recovery, and have a bearing on the theory of the collision of elastic solids developed mathematically by Hertz.

Figs. 1, 2, and 3 are pictures of the percussion figure, taken from three different points of view, produced on the surface of a thick glass plate by the impact of a polished hard steel ball. Near the centre of the region of contact between the sphere and the plate the stresses are mainly in the nature of a volume-compression, and fracture accordingly does not originate there, but occurs at or near the *margin* of the compressed area in the form of a fine circular crack which spreads inwards into the plate obliquely in the form of a surface of revolution. This is clearly shown in Fig. 1, which is a front view of the percussion figure by reflected light, the dark circle in the middle being the uninjured area of contact between ball and plate. The circular interference-rings seen in the picture are a measure of the separation of

FIG. 1.



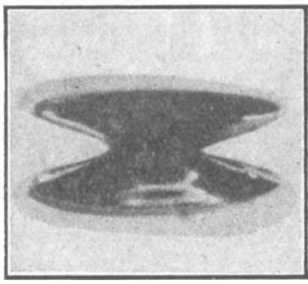


FIG. 2.

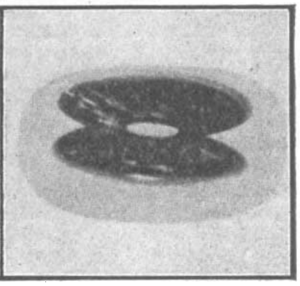


FIG. 3.

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the surfaces of the internal fracture within the plate.

Fig. 2 is a side view, and Fig. 3 an oblique view, of the internal fracture seen through the edge of the plate, the lower half of each picture being the image of the upper half formed by the reflection of light at the interior surface of the plate. The circular area of contact from the margin of which the fracture starts appears in Fig. 3 as an elliptic white disc at the centre. It seems clear that the internal fracture practically occurs along the surface of maximum *shearing* stress set up during the impact. C. V. RAMAN.

210 Bowbazaar Street, Calcutta, August 18.

The Rigidity of the Earth.

AN account of an experiment to determine the rigidity of the earth was published in the *Astrophysical Journal* and in the *Journal of Geology*, March, 1914. This gave the ratios of the amplitudes of tides observed in N-S and E-W pipes to the amplitudes computed for the same pipes on the assumption of a perfectly rigid earth as 0·523 and 0·710 respectively. The work of reducing a new set of automatically recorded observations made by an interference method, which was interrupted by the war, was recently resumed, and it was found that the N-S and E-W ratios were very nearly equal to each other.

It was then noted that 0·523/0·710=0·7366, and that the cosine of the latitude of Yerkes Observatory, where the experiment was performed, is 0·7363. It seemed highly probable, therefore, that cos ϕ had been introduced erroneously into the computed formula for for N-S tides.

We have just been informed by Prof. Moulton that he has gone over the old formulæ used, and has found that the computer introduced the factor cos ϕ erroneously into the N-S computation.

The N-S ratio should therefore have been 0·523/0·7363=0·710, which, oddly enough, is exactly equal to the E-W ratio.

The new observations point to a value of about 0·69 for both E-W and N-S ratios.

A. A. MICHELSON.
HENRY G. GALE.

University of Chicago, September 10.

The "Flying Gallop" in Art.

IN NATURE of August 21 (p. 489) reference is made to a popular article by Mr. C. W. Bishop on "The Chinese Horse," and to the distribution of the artistic motive of the flying gallop dealt with in it. It may be of interest to remark that this problem was first studied and discussed by the famous French archæologist S. Reinach in his "La représentation du galop dans l'art ancien et moderne" (Paris, 1901), and was afterwards expanded by me in my book, "Chinese Pottery of the Han Dynasty" (Leyden, 1909), where also many illustrations of the motive from Chinese art-works are given.

B. LAUFER,
Curator of Anthropology.

Field Museum, Chicago, September 10.

MUSEUMS, EDUCATION, AND THE BOARD.

FOR many years a number of our provincial museums have striven to make their collections of educational value, both to the ordinary citizen through their exhibits and guides, and to the schools through their exhibits and special circulating collections, as well as by talks to the teachers or pupils. The response of the education authorities long continued disappointing, but some eight or ten years ago things began to move more rapidly. Certain pure educationists began to see that there was something of value for them in the museums, and in 1913 the Educational Science Section of the British Association appointed a strong committee to report on the question. The war, though unfortunately preventing the publication of that committee's lengthy report, and hindering museum activities in many directions, has had the result in some towns, notably Manchester, of inducing the schools to lighten their own troubles by seeking the aid of the museums and their staffs.

So well had the movement progressed, thanks mainly to the insistent propaganda of museum officials, individually and through the Museums Association, that at last the Education Act of 1918 and the draft suggestions for the arrangement of schemes thereunder (Circular 1096) took museums into serious account as an educational factor. Museum enthusiasts were delighted. But now comes a move which gives them pause. The Adult Education Committee of the Ministry of Reconstruction has issued an interim report (Cd. 9237) recommending that public libraries and museums should be placed under the control of the local education authorities, and administered by special committees of those bodies, and urging "that the powers and duties of the Local Government Board regarding public libraries and museums should be transferred forthwith to the Board of Education." So reasonable a recommendation would, it is doubtless expected, be welcomed effusively by the institutions concerned. The contrary is the case. The protests of the librarians are quoted—and dismissed—in the interim report itself. They have just been repeated at the meeting of the Library Association in Southport, but we cannot consider them here. As already reported (NATURE, July 17, 1919, p. 394), the Oxford meeting of the Museums Association raised so many objections that it appointed a committee to prepare a statement. And now, in a discussion of the Educational Science Section of the British Association, the opposition of the museums found vigorous expression, and such support as the proposal received from one or two curators was only half-hearted. It may be well, therefore, to summarise the arguments.

The Adult Education Committee holds its opinion so strongly that it has condescended to very little argument. We gather more from a paper laid before Section L by Prof. J. A. Green. This assumes that museums are "fundamentally educational in character," and infers that they should form part of the educational machinery of the country. This machinery should be controlled by one authority, and its parts adapted to a common aim. This would change the outlook of the museums and lead them to display their collections in such a way as to dispel "museum headache." The responsibilities of the Education Committees have been extended to adult education, and they would be better able to bring museums

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